



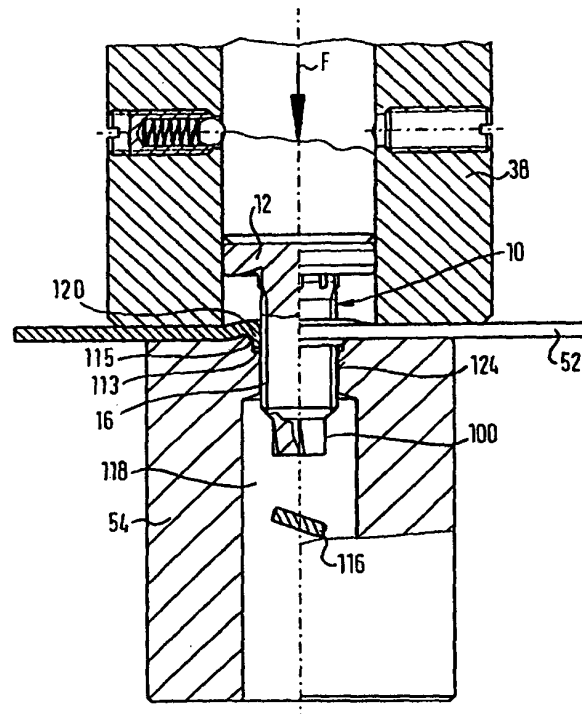
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/EP96/04188 (22) International Filing Date: 25 September 1996 (25.09.96) (30) Priority Data: 195 35 537.7 25 September 1995 (25.09.95) DE 25 Mar 98 / 30 msz (71) Applicant (for all designated States except US): PROFIL VERBINDUNGSTECHNIK GMBH & CO. KG [DE/DE]; Otto-Hahn-Strasse 22-24, D-61381 Friedrichsdorf (DE). (72) Inventor; and (75) Inventor/Applicant (for US only): MÜLLER, Rudolf [DE/DE]; Fasanenweg 6, D-60437 Frankfurt am Main (DE). (74) Agent: MANITZ, FINSTERWALD & PARTNER; Robert-Koch-Strasse 1, D-80538 München (DE).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: METHOD OF INSERTING A FASTENER ELEMENT, BOLT ELEMENT, RIVETING DIE AND COMPONENT ASSEMBLY

(57) Abstract

In a method for inserting a bolt element (10) having a head portion (12) and a shaft portion (16) into a sheet metal component (52) the bolt element is passed through the sheet metal component by means of a setting head (38), with its end (100) remote from the head portion at the front, and is riveted to the sheet metal component (52) in the region of its head portion (12) by the cooperation of the setting head with a die (54) arranged at the side of the sheet metal component remote from the setting head (38). The sheet metal component (52) is pierced either by a hole punch or by the specially shaped bolt element (10), by the end of the shaft portion (16) remote from the head portion (12) under the action of the setting head (38), to form a ring collar which is subsequently deformed radially into contact with a groove in the shaft portion. In this arrangement the end (100) of the bolt element (10) which performs the punching work is preferably executed in accordance with the Ka shape of DIN 78.



INTERNATIONAL SEARCH REPORT

Int. Application No

PCT/EP 96/04188

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B23P19/06 F16B37/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B23P F16B B21K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	US,A,3 967 669 (EGNER) 6 July 1976 see the whole document	1,32 2,29,30 3,4,9, 17,32,38
Y A	--- US,A,3 782 436 (STEINER) 1 January 1974 see column 2, line 36 - line 61; figures	2,29,30 1,9,10, 17,32,38
X A	--- WO,A,94 01688 (R. BERGNER GMBH) 20 January 1994 cited in the application see the whole document	1,32 10,17, 32,38, 42-45, 47-51
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☒ Further documents are listed in the continuation of box C.

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* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
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- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search

15 January 1997

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Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 96/04188

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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P,A	WO,A,95 27147 (TEXTRON INC) 12 October 1995 see abstract; claims; figures ---	1,10,17, 28,29, 32,38,47
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A	US,A,3 827 131 (COLTRIN) 6 August 1974 see column 4, line 7 - line 42; figures ---	1-7,10, 11,38-42
A	GB,A,2 112 893 (AVDEL LIMITED) 27 July 1983 see abstract; figures see page 2, line 45 - line 51 ---	1,2,9, 10,29, 31,38
A	DE,C,37 04 763 (W. VOIT GMBH & CO) 13 October 1988 cited in the application see claim; figures ---	1,10,29, 32,38,47
A	US,A,4 637 766 (MILLISER) 20 January 1987 see figures -----	14-28

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 96/04188

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-3967669	06-07-76	NONE	
US-A-3782436	01-01-74	AU-B- 471840	06-05-76
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US-A-4637766	20-01-87	NONE	

Patent Claims

1. Method of joining a bolt or fastener element, having a head portion, a shaft portion and at least one radial groove or one or more thread turns (28) on its shaft portion, to a sheet metal component (52) by pre-forming a hole in said sheet metal component or by punching a hole in said sheet metal component using the tip of the shaft portion of said fastener element remote from said head portion, characterised in that the pre-forming or punching of said hole is effected in such a way that a collar (120) of material is formed at the side of the sheet metal component remote from the head portion of said fastener element, and in that the material of said collar (120) is subsequently deformed radially inwardly into said radial groove or thread turns (28).
2. Method in accordance with claim 1, wherein said radial deformation is achieved using a die button having a tapered recess (112) surrounding said collar, with a base portion (113) of said recess preferably serving to define the axially outermost end of said collar when deformed into engagement with said element.
3. Method in accordance with claim 2, comprising the steps guiding the fastener element by means of a setting head through the sheet metal component (52) or through another plate-like component consisting of deformable material with said tip at the front, wherein the sheet metal component (52) is pierced by the end (100) of the shaft portion (16) remote from the head portion (12) under the action of the setting head (38), with a slug (116) being formed on penetration of the sheet metal component (52), characterised in that the hole formed in the sheet metal part (52) by the ejected slug (116) is

broadened by the pushing through of the thread (14) formed at the shaft part (16) of the bolt element, with the simultaneous dilation of a collar (120) which is located around the hole on the die side.

4. Method in accordance with claim 3, wherein said collar (120) which is formed during the piercing of said sheet metal component and which surrounds said hole at the die side is dilated as said shaft portion is pushed through said hole.
5. Method in accordance with claim 3 or claim 4, characterised in that the end (100) of the shaft portion (16) remote from the head portion (12) is used not only to push out the slug (116) from the sheet metal component (52), but rather also to generate at least one and preferably a plurality, and in particular a non-even number of notches, or at least substantially radially directed cuts or tears in the rim of the hole.
6. Method in accordance with any one of the claims 3, 4 or 5, characterised in that the piercing of said sheet metal component is effected using a bolt element (10) which has a spigot-like projection (101) at its end (100) remote from the head portion (12), with said projection having a diameter which is somewhat smaller than the core diameter of the thread.
7. Method in accordance with claim 6, wherein a conically divergent portion of said spigot adjacent said thread is used for initial dilation of said hole.
8. Method in accordance with claim 7, wherein shape features (106) provided at said spigot-like projection are used to exert a cutting action at the rim of said hole.

9. Method in accordance with any one of the preceding claims, wherein a ring-shaped projection is provided at an end face of said die button surrounding said tapered recess and has sloping flanks for pressing said sheet metal component upwardly into a recess provided under said head portion of said fastener element (10) and radially inwardly towards said shaft portion in the transition from said head portion to said shaft portion.
10. A fastener element (10) which can be inserted by riveting into a sheet metal component (52), in particular a bolt element (10), the element (10) consisting of a shaft portion (16) and a head portion (12) formed in one piece therewith, in particular for carrying out the method in accordance with one of the claims 1 to 9, wherein the rivet connection to the sheet metal component takes place in the region of the head portion (12) and wherein the shaft portion (16), which is preferably equipped with a thread, is formed at its end remote from the head portion (12) to punch through the sheet metal component, characterised in that the end (100) of the shaft portion (16) remote from the head portion (12) has a spigot-like projection (101), having an outer diameter which is smaller than the core diameter of the shaft portion, said shaft portion preferably being provided with a thread, and in that the spigot-like projection (101) has at least one, and preferably a plurality of cutting features (106), in particular a non-even number of cutting features which, on punching through the sheet metal component, slightly notch or tear the rim of the hole at the corresponding positions.
11. Bolt element in accordance with claim 10, characterised in that the spigot-like projection (101) merges via a

truncated cone section (102) into the thread, the truncated cone section preferably having a cone angle of approximately 90°.

12. Bolt element in accordance with claim 11, characterised in that the cutting features (106) are formed by grooves which extend in the longitudinal direction of the projection (101) and which are in particular of V-shape in cross-section and the depth of which reduces in the axial direction of the shaft portion in the direction towards the thread and preferably goes to zero in front of the thread, with the one side wall (108) of each V-shaped groove preferably lying in a radial plane.
13. Bolt element in accordance with claim 11, characterised in that the cutting features are formed by ribs on the spigot-like projection in the longitudinal direction thereof, with the ribs preferably lying within a circle coaxial to the thread, said circle having a diameter smaller than the core diameter of the thread.
14. Bolt element in accordance with any one of the claims 10 to 13, characterised in that the spigot-like projection has a so-called Ka-shape in accordance with DIN 78 or an Asp-shape in accordance with DIN 78 (German Industrial Standard 78).
15. Bolt element in accordance with one of the preceding claims 10 to 14, characterised in that the end face (104) of the shaft portion remote from the head portion (12) is a surface which is at least substantially perpendicular to the mean longitudinal axis of the bolt element and which can optionally be slightly concave or convex.

16. Bolt element in accordance with one of the preceding claims 10 to 15, characterised in that the first thread turns of the thread (14) are made substantially harder than the following turns of the thread.
17. Bolt element in accordance with one of the preceding claims 10 to 16, characterised in that the head portion (12) of the bolt element is formed in accordance with the German patent application P 44 10 475.8, and in particular in that the element (10) has peripherally closed fields at its concave lower side serving as a contact surface (18), with the concave fields being at least partly bounded by ribs (22) extending outwardly away from the shaft portion (16), and with the shaft side ends (24) of the ribs (22) extending in raised form along the shaft portion (16) and merging at the ends (26) remote from the head portion (12) into at least one recess (28) extending spirally around the shaft portion.
18. Bolt element in accordance with claim 17, characterised in that the shaft portion (16) of the element has a larger diameter in the region of the raised ribs (28) in comparison to the shaft portion (16) remote from the head portion (12), with the at least one recess (28) being located in this region of greater diameter.
19. Bolt element in accordance with claim 17 or claim 18, characterised in that the peripherally closed fields (20) have their greatest depth adjacent to the shaft portion (16).
20. Bolt element in accordance with one of the preceding claims 17 to 19, characterised in that the proportion of the area of the fields in comparison to the contact surface (18) of the head portion are so selected that

they result in an ideal security against rotation and non-critical surface pressure taking account of the material pairing.

21. Bolt element in accordance with one of the preceding claims 17 to 20, characterised in that the closed fields (20) are bounded at their radially outer boundary by a peripheral surface (30) of the head portion (12).
22. Bolt element in accordance with one of the preceding claims 17 to 20, characterised in that the rib parts (22) which are located in the contact region of the head portion (12) and preferably extend in the radial direction become broader radially outwardly and merge without interruption into a peripheral surface (20) of the contact region (18) of the head portion (12).
23. Bolt element in accordance with one of the preceding claims 17 to 22, characterised in that the number of ribs (22) preferably lies between 6 and 8.
24. Bolt element in accordance with one of the preceding claims 17 to 23, characterised in that the closed fields (22) are at least substantially square in plan view.
25. Bolt element in accordance with one of the preceding claims 17 to 24, characterised in that the base surfaces of the closed fields (20) lie at least substantially on a conical surface having an included angle (α) of preferably 130° to 140°.
26. Bolt element in accordance with one of the preceding claims 17 to 25, characterised in that the side of the head portion (12) remote from the contact surface (18) has a centring recess (34) extending coaxial to the

longitudinal axis of the element.

27. Bolt element in accordance with one of the claims 17 to 26, characterised in that the element (10) has a thread (14), with the at least one spiral recess (28) being formed by a thread groove.
28. Bolt element in accordance with one of the preceding claims 8 to 27, characterised in that it is a functional part, for example a bearing spigot.
29. Riveting die, in particular for use with a bolt element in accordance with one of the preceding claims 8 to 28, characterised in that, for the generation of a plastic deformation of the sheet metal material, it has either a peripherally extending wave-like end face having hills (72) and valleys (74) in the axial direction, or has a roof-like ring wall at the end surface, with the end surface having a central ring recess with a diameter larger than the outer diameter of the thread and which merges via a ring shoulder into a smaller diameter which is fractionally larger than the outer diameter of the thread .
30. Riveting die in accordance with claim 29, wherein said central ring recess has a wall 115 which tapers in diameter in the direction of the insertion of said bolt element.
31. Riveting die in accordance with claim 29 or 30, characterised in that said ring recess has a ring-step at its end remote from the roof-like ring wall.
32. Component assembly comprising a sheet metal component (52) and a bolt or nut element (10) having a radial

groove or one or more thread turns at its shaft portion adjacent to a head portion, in particular a bolt element in accordance with one of the preceding claims 10 to 28, wherein the metal of the sheet metal component (52) is at least partly plastically deformed into the closed fields (20) and into the at least one recess (28), characterised in that the sheet metal comprises a ring collar (113) at the side remote from said head portion, said ring collar being deformed radially inwardly into said radial groove or said one or more thread turns (28).

33. Component assembly in accordance with claim 32, characterised in that the radially outer contour of said collar and its projection beyond the adjacent face of said sheet metal component are selected so that they lie, at least at the end remote from said sheet metal component, within or at most just contacting a recess within a nut element threaded onto said shaft portion and used to secure a second sheet metal component to the first said sheet metal component, said second sheet metal component having an aperture therein which fits with clearance around said collar.
34. Component assembly in accordance with claim 32, characterised in that the sheet metal component (52) has a groove (80) which extends at the side opposite to the contact surface (18) of the head portion (12) substantially coaxial to the longitudinal axis of the element and which is optionally interrupted.
35. Component assembly in accordance with claim 34, characterised in that the groove (80) has a wave-like base surface (81).

36. Component assembly in accordance with the claims 34 to 35, characterised in that regions which are raised above the plane of the sheet metal component (52) are provided between the groove sections of an interrupted groove (80) for electrical contact purposes.
37. Component assembly in accordance with any one of claims 32 to 36, wherein said collar (120) has a conically tapering outer surface which tapers in the direction away from said head portion (12).
38. A method of attaching a fastener element to a plastically deformable metal panel, said fastener element including a shank portion and an integral head portion extending radially from one end of said shank portion, and said shank portion including a radial groove generally adjacent said head portion, said method comprising the following steps:
- forming an opening in said panel having a diameter generally equal to or greater than said fastener element shank portion, but less than said head portion,
 - deforming said panel surrounding said panel opening into a generally cone-shaped portion projecting from said panel having a minor diameter at said panel opening,
 - disposing said fastener element shank portion through said panel opening from a side of said panel opposite said projecting cone-shaped portion, and
 - then deforming said panel cone-shaped portion into a generally tube-shaped portion closely conforming said fastener element shank portion, thereby supporting said

shank portion, and deforming said tube-shaped portion radially inwardly into said shank portion radial groove, thereby preventing withdrawal of said fastener from said panel opening.

39. The method of attaching a fastener element to a panel in accordance with claim 38, wherein said fastener element shank portion includes a generally cylindrical free end portion having a generally smooth external surface, said method including driving said fastener element free end portion against said panel, thereby generally simultaneously deforming said panel to form said cone-shaped portion and piercing a slug from said panel, forming said panel opening.
40. The method of attaching a fastener element to a panel in accordance with claim 39, wherein said fastener element cylindrical free end portion has a diameter less than said shank portion and said shank portion including a generally conical portion extending inwardly from said shank portion to said cylindrical free end portion, said method including driving said cylindrical free end portion of said shank portion through said panel as defined in claim 39, then driving said conical portion of said fastener element shank portion through said panel opening, thereby enlarging said panel opening and substantially simultaneously drawing said conical panel portion into said tubular-shaped panel portion, then deforming said tubular panel portion radially inwardly into said shank portion radial groove.
41. The method of attaching a fastener element to a panel in accordance with claim 40, wherein said cylindrical free end portion of said shank portion includes generally longitudinally extending spaced grooves having relative-

ly sharp edges adjacent the cylindrical surface of said cylindrical end portion, said method including driving said cylindrical end portion against said panel, tearing and piercing said panel, and forming said generally conical panel portion having a torn discontinuous edge surrounding said panel opening, then deforming said discontinuous edge radially inwardly into said radial groove in said shank portion.

42. The method of attaching a fastener element to a panel in accordance with claim 40, wherein said shank portion is externally threaded and said radial groove comprises at least one male thread generally adjacent said head portion, said method including deforming said panel tubular portion radially inwardly into the groove defined by said one male thread.
43. The method of attaching a fastener element to a panel in accordance with claim 40, wherein said radial groove in said shank portion is spaced from said head portion, said method including deforming the end of said panel tubular portion radially inwardly into said radial groove in said shank portion.
44. The method of attaching a fastener element to a panel in accordance with claim 38, wherein said fastener element head portion includes a groove generally adjacent said shank portion, said method including deforming said conical panel portion spaced from said panel opening into said groove in said head portion substantially simultaneously with deforming said panel portion radially inwardly into said radial groove in said fastener element shank portion.

45. The method of attaching a fastener element to a panel in accordance with claim 38, wherein said shank portion of said fastener element includes a first radial groove immediately adjacent said head portion and said shank portion is externally threaded including a first plurality of male threads adjacent said first radial groove having a diameter greater than the remaining threads on said shank portion, said method including deforming said generally tube-shaped panel portion radially inwardly into said first radial groove and the radial grooves defined by said first plurality of male threads.
46. The method of attaching a fastener element to a panel in accordance with claim 45, wherein said method includes hardening said first plurality of male threads adjacent said radial groove prior to attachment of said fastener element to said panel.
47. A male fastener element for attachment to a plastically deformable metal panel, said male fastener element including a generally cylindrical shank portion having a free end and an enlarged integral, radially extending head portion at one end of said shank portion, said shank portion externally threaded to adjacent said free end portion with said free end portion having a relatively smooth cylindrical surface including a plurality of generally longitudinally extending cutting grooves having relatively sharp cutting edges adjacent said smooth cylindrical surface.
48. The male fastener element in accordance with claim 47, wherein said smooth cylindrical free end portion of said male fastener element has a diameter less than the diameter of said externally threaded portion and said shank portion includes a relatively smooth conical portion

extending from said threaded portion to said relatively smooth cylindrical surface of said fee end portion.

49. The male fastener element in accordance with claim 47, wherein said shank portion is threaded to adjacent said head portion, including a first plurality of male threads adjacent said head portion having a diameter greater than the remaining threads on said shank portion and wherein said first plurality of threads is hardened relative to said remaining threads.
50. The male fastener element in accordance with claim 47, wherein said head portion includes a groove surrounding said shank portion extending angularly inwardly to said shank portion.
51. The male fastener element in accordance with claim 50, wherein said shank portion includes a relatively smooth radial groove adjacent said head portion.

TENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference P 3546	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/EP 96/ 04188	International filing date (day/month/year) 25/09/1996	(Earliest) Priority Date (day/month/year) 25/09/1995
Applicant PROFIL VERBINDUNGSTECHNIK GMBH & CO. KG et al.		
<p>This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.</p> <p>This International Search Report consists of a total of <u>3</u> sheets. <input checked="" type="checkbox"/> It is also accompanied by a copy of each prior art document cited in this report.</p>		
<p>1. <input type="checkbox"/> Certain claims were found unsearchable (see Box I).</p> <p>2. <input type="checkbox"/> Unity of invention is lacking (see Box II).</p> <p>3. <input type="checkbox"/> The international application contains disclosure of a nucleotide and/or amino acid sequence listing and the international search was carried out on the basis of the sequence listing <input type="checkbox"/> filed with the international application. <input type="checkbox"/> furnished by the applicant separately from the international application, <input type="checkbox"/> but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed. <input type="checkbox"/> Transcribed by this Authority</p> <p>4. With regard to the title, <input checked="" type="checkbox"/> the text is approved as submitted by the applicant. <input type="checkbox"/> the text has been established by this Authority to read as follows:</p> <p>5. With regard to the abstract, <input checked="" type="checkbox"/> the text is approved as submitted by the applicant. <input type="checkbox"/> the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.</p> <p>6. The figure of the drawings to be published with the abstract is: Figure No. <u>14</u> <input checked="" type="checkbox"/> as suggested by the applicant. <input type="checkbox"/> None of the figures. <input type="checkbox"/> because the applicant failed to suggest a figure. <input type="checkbox"/> because this figure better characterizes the invention.</p>		

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 96/04188

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B23P19/06 F16B37/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B23P F16B B21K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	US,A,3 967 669 (EGNER) 6 July 1976 see the whole document	1,32 2,29,30 3,4,9, 17,32,38
Y A	US,A,3 782 436 (STEINER) 1 January 1974 see column 2, line 36 - line 61; figures	2,29,30 1,9,10, 17,32,38
X A	WO,A,94 01688 (R. BERGNER GMBH) 20 January 1994 cited in the application see the whole document	1,32 10,17, 32,38, 42-45, 47-51

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Date of the actual completion of the international search

15 January 1997

Date of mailing of the international search report

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Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 96/04188

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	DE,A,44 10 475 (PROFIL-VERBINDUNGSTECHNIK GMBH) 28 September 1995 cited in the application see the whole document ---	1,10, 17-29, 32-38,47
P,A	WO,A,95 27147 (TEXTRON INC) 12 October 1995 see abstract; claims; figures ---	1,10,17, 28,29, 32,38,47
A	GB,A,949 811 (BELLING & LEE LTD) 19 February 1964 see the whole document ---	1-7,10, 11,15, 38-42,47
A	US,A,3 827 131 (COLTRIN) 6 August 1974 see column 4, line 7 - line 42; figures ---	1-7,10, 11,38-42
A	GB,A,2 112 893 (AVDEL LIMITED) 27 July 1983 see abstract; figures see page 2, line 45 - line 51 ---	1,2,9, 10,29, 31,38
A	DE,C,37 04 763 (W. VOIT GMBH & CO) 13 October 1988 cited in the application see claim; figures ---	1,10,29, 32,38,47
A	US,A,4 637 766 (MILLISER) 20 January 1987 see figures -----	14-28

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 96/04188

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-3967669	06-07-76	NONE	
US-A-3782436	01-01-74	AU-B- 471840	06-05-76
		AU-A- 5827973	23-01-75
		CA-A- 979793	16-12-75
		DE-A- 2337037	31-01-74
		FR-A- 2194254	22-02-74
		GB-A- 1431860	14-04-76
		JP-A- 49045250	30-04-74
		JP-B- 56048730	17-11-81
		NL-A- 7309644	23-01-74
WO-A-9401688	20-01-94	CZ-A- 9402874	15-11-95
		EP-A- 0667936	23-08-95
		PL-A- 306310	20-03-95
		SK-A- 141494	09-08-95
DE-A-4410475	28-09-95	CA-A- 2185807	05-10-95
		EP-A- 0678679	25-10-95
		WO-A- 9526256	05-10-95
		US-A- 5528812	25-06-96
WO-A-9527147	12-10-95	US-A- 5513933	07-05-96
GB-A-949811		NONE	
US-A-3827131	06-08-74	NONE	
GB-A-2112893	27-07-83	NONE	
DE-C-3704763	13-10-88	NONE	
US-A-4637766	20-01-87	NONE	

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

United States Patent and Trademark
Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 14 May 1997 (14.05.97)	
International application No. PCT/EP96/04188 ✓	Applicant's or agent's file reference P 3546
International filing date (day/month/year) 25 September 1996 (25.09.96)	Priority date (day/month/year) 25 September 1995 (25.09.95)
Applicant MÜLLER, Rudolf	

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

22 April 1997 (22.04.97)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer M. Abidine Telephone No.: (41-22) 730.91.11
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PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

<p>To:</p> <p>MORGAN, James G. MANITZ, FINSTERWALD & PARTNER Robert-Koch-Strasse 1 D-80538 München ALLEMAGNE</p>	<p>Patent- und Rechtsanwälte Manitz, Finsterwald & Partner</p> <p>29. DEZ. 1997</p> <p>Bearb.: _____ EF: _____ Frist: _____ Ablage: _____</p>	<p>PCT</p> <p>NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Rule 71.1)</p>
		<p>Date of mailing (day/month/year) 23. 12. 97</p>

<p>Applicant's or agent's file reference P 3546 - R/Sb</p>	<p>IMPORTANT NOTIFICATION</p>
<p>International application No. PCT/EP96/04188</p>	<p>International filing date (day/month/year) 25/09/1996</p>
<p>Priority date (day/month/year) 25/09/1995</p>	
<p>Applicant PROFIL VERBINDUNGSTECHNIK GMBH & CO. KG et al.</p>	

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

<p>Name and mailing address of the IPEA/</p> <p> European Patent Office D-80298 Munich Tel. (+49-89) 2399-0. Tx: 523656 epmu d Fax: (+49-89) 2399-4465</p>	<p>Authorized officer</p> <p>Rinser, A</p> <p>Tel. (+49-89) 2399-2911</p>
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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P 3546 - R/Sb	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (PCT/IPEA/416)	
International application No. PCT/EP96/04188	International filing date (day/month/year) 25/09/1996	Priority date (day/month/year) 25/09/1995
International Patent Classification (IPC) or national classification and IPC B23P19/06		
Applicant PROFIL VERBINDUNGSTECHNIK GMBH & CO. KG et al.		



1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 10 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 14 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☒ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 22/04/1997	Date of completion of this report
Name and mailing address of the IPEA/  European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Authorized officer Gelder, K Telephone No. (+49-89) 2399-2421 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP96/04188

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-38 as originally filed

Claims, No.:

1-52 as received on 23/10/1997 with letter of 23/10/1997

Drawings, sheets:

1/11-11/11 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.
- ☐ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/EP96/04188

2. ☒ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
- ☐ complied with.
- ☒ not complied with for the following reasons:

see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☒ all parts.
- ☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims 1 - 52
	No: Claims
Inventive step (IS)	Yes: Claims 1 - 8, 10 - 28, 32 - 38, 48 - 52
	No: Claims 9, 29 - 31, 39 - 47
Industrial applicability (IA)	Yes: Claims 1 - 52
	No: Claims

2. Citations and explanations

see separate sheet

VI. Certain documents cited

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

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**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/EP96/04188

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

1. Lack of unity

The separate groups of invention are: (1) Claims 1 - 9, 39 - 47; (2) Claims 10 - 28, and 48 - 52; (3) Claims 29 - 31; and (4) Claims 32 - 38.

They are not so linked as to form a single general inventive concept for the following reasons:

Group (1) relates to a die button design for the purpose of better flow of material into the recesses and grooves of the fastener element.

Group (2) relates to a fastener element as such, whereby a spigot-like projection has at least one cutting feature, which may be used for punching through a sheet metal component.

Group (3) relates to a riveting die having two different end face designs, which cannot be considered to be specifically for use with a fastener element of group (2) or for carrying out the method of group (1).

Group (4) relates to a component assembly with a bolt or nut element having a specific rib design, i.e. the ribs extending in raised form along the shaft portion and merging at the ends remote from the head portion into the radial groove, whereby a reliable form-locked connection between the bolt or nut element and the sheet metal component is achieved.

It should be noted that the references in claims 10 and 29 to claims of other categories are only optional due to the wording "in particular". Even without such non-binding term, the formulations "for carrying out the method in accordance with one of claims..." and "for use with a bolt element in accordance with one of claims ...", express only, that the bolt element and riveting die are suitable for such use.

2. Lack of clarity and conciseness

- 2.1 The various definitions of the invention given in independent claims 1 and 39 (group (1)) as well as 10 and 48 (group (2)), respectively, are such that the claims as a whole are not clear and concise, contrary to Article 6 PCT. The claims should

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP96/04188

therefore have been recast to include only one independent method and one independent fastener element claim, with dependent claims as appropriate (Rule 6.4(a)-(c) PCT).

- 2.2 Claim 9 is not truly dependent on claim 1 but rather extends the scope of claim 1 by defining an alternative, thus rendering the claims unclear (Article 6 PCT). In claim 1, the radial groove is defined as being located "in the transition from said head portion to said shaft portion", whereas claim 9 defines the radial groove as being formed by one or more thread turns on the shaft portion.
- 2.3 According to claim 1, a hole in the sheet metal component is formed such that a collar of material is formed at the side of the sheet metal component remote from the header portion of the fastener element. The description, p. 31, penultimate paragraph, mentions forming of the hole by drilling without a collar being formed, in contradiction to what is claimed in claim 1, thus rendering claim 1 unclear.
- 2.4 Claim 17 contains a reference to DE-A-44 10 475. Such reference renders the claim unclear (Art. 6 PCT). In addition, according to Rule 6.2(a) PCT, claims should not contain references to the description and drawings except where is absolutely necessary. Such is not, however, the case here. The claim should thus have been reformulated so as to make the intended limitations clear without referring to this document.
- 2.5 Claims 28 and 29 should refer back to claim 10 instead of claim 8 for obvious reasons.
- 2.6 Claim 29 is directed to a riveting die as such. It contains, however, features of its use by referring to the fastener element ("a diameter larger than the outer diameter of the thread"; "a smaller diameter which is fractionally larger than the outer diameter of the thread"), resulting in a lack of clarity (Article 6 PCT, see also PCT/GL/3, Chapter III, 4.8a).
- 2.7 In addition, the term "roof-like ring wall" in claim 29 is ambiguous, in particular it does not, by necessity, imply the limitations explicitly defined in claim 1.

- 2.8 Claim 29 includes two different embodiments ("wave-like end face" and "roof-like ring wall at the end surface"). It is not clear whether the feature concerning the central ring recess is mandatory also for the "wave-like end face" embodiment.
- 2.9 Claim 29 defines a ring shoulder. Claim 31 dependent on claim 29 defines a ring step. It is not clear, in particular in view of the description and drawings, whether the ring shoulder is the ring step or whether there is a ring shoulder and a ring step.
- 2.10 Claim 32 defines a component assembly, i.e. a product. It contains, however, features of its manufacturing process and structural features of an intermediate product ("wherein the sheet metal comprises a ring collar at the side remote from said head portion, said ring collar being deformed radially inwardly into said radial groove"). The restrictions intended by such features are not clear. It should be noted that such features have no limiting effect on the scope of the product per se.
- 2.11 Claim 41 contains a reference to claim 40 (line 2) and a reference to claim 39 (line 7). It appears that the second reference should also read "claim 40".

3. Novelty

- 3.1 Earlier (25.03.1994) patent applications DE-A-44 10 475, published 28.09.95, (&WO-A-95/26256, publ. 05.10.1995, &EP-A-0 678 679, publ. 25.10.1995) were published after priority date of the present application.

Note that no examination has been carried out on the question, whether the priority of the present international application is valid. On the assumption that the priority is validly claimed, these documents do not constitute state of the art according to Rule 64.1 b) PCT. It appears that each of these documents discloses the subject-matter of claims 29 to 31 and 32 to 38, respectively.

4. Inventive step

4.1 Claims 1 - 9

A method according to the preamble of claim 1 is disclosed in US-A-3 967 669 (D1). The underhead design of the fastener element defined in the characterising part of claim 1 ("recess provided under said head portion") is also known from D1, see for example Figure 4.

The use of a die button shaped as defined in the characterising part of claim 1 supports flow of material into the recess and groove of the fastener element, thereby improving the strength of the connection between the fastener element and the sheet metal component. Use of such a die button is not hinted at by the available prior art according to Rule 64.1 b) PCT. Consequently, the subject-matter of claim 1 involves an inventive step within the meaning of Article 33(3) PCT). Claims 2 - 8 are truly dependent on claim 1 and as such also meet the requirements of the PCT with respect to inventive step.

The tapered recess of die button as defined in claim 1 is for pressing the sheet metal component upwardly into a recess provided under said head portion of said fastener element and radially inwardly towards said shaft portion into said radial groove in the transition from said head portion to said shaft portion. Claim 9 does not include the inventive concept of claim 1, since such a groove in the transition from the head portion to the shaft portion does not exist, as implied by claim 9, defining the radial groove as being formed by thread turns on the shaft portion.

4.2 Claims 39 - 47

The only feature distinguishing claim 39 over D1 is the use of a die button having a tapered recess, resulting in a tapered outer surface of the collar. Such die buttons have already been employed for the same purpose, see US-A-3 782 436 (D2), see Figures 5 and 6. Therefore, the skilled person would regard it a normal design procedure to combine all the features set out in claim 39. Thus, the subject-matter of claim 39 does not involve an inventive step, and claim 39 does not satisfy the criteria set forth in Article 33(1) PCT.

Dependent claims 40 to 47 do not appear to contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step.

4.3 Claims 10 to 28 and 48 to 52

The subject-matter of claim 10 and 48, respectively, differs from the fastener element described in WO-A-94/01688 (D3), in that the spigot-like projection or free end portion is provided with at least one cutting feature for the purpose of notching or tearing the rim of the hole of the sheet metal component on punching through the sheet metal component. This solution is not hinted at by the available prior art according to Rule 64.1 b) PCT. Consequently, the subject-matter of claims 10 and 48 involves an inventive step within the meaning of Article 33(3) PCT). Claims 11 - 28 and 49 - 52 are dependent on claims 10 and 48, respectively, and as such also meet the requirements of the PCT with respect to inventive step.

4.4 Claims 29 - 31

Due to the unclear and incomplete definition of the subject-matters indicated in claims 29 - 31, it is not apparent what is effected by them. Therefore, they cannot be regarded as inventive.

4.5 Claims 32 to 38

The component assembly defined in claim 32 differs from the assembly described in D3 in that the ribs extend in raised form along the shaft portion and merging at the ends remote from the head portion into the radial groove, resulting in a more reliable form-locked connection between the bolt or nut element and the sheet metal component is achieved. Such a rib design is not rendered obvious by the available prior art according to Rule 64.1 b) PCT. Consequently, the subject-matter of claim 32 involves an inventive step within the meaning of Article 33(3) PCT). Claims 33 - 38 are dependent on claim 32 and as such also meet the requirements of the PCT with respect to inventive step.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP96/04188

5. Request for correction of claim 1

With letter of 25.11.97, the applicant has requested deletion of the word "is" after "being" in line 7 of claim 1. The applicant's attention is drawn to the fact that, as a consequence of Rule 66.8(a) PCT, the examiner is not permitted to carry out any amendments under the PCT procedure, however minor these may be.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

20

REC'D 29 DEC 1997

WIPO PCT

Applicant's or agent's file reference P 3546 - R/Sb	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (PCT/IPEA/416)
International application No. PCT/EP96/04188	International filing date (day/month/year) 25/09/1996	Priority date (day/month/year) 25/09/1995	
International Patent Classification (IPC) or national classification and IPC B23P19/06			
Applicant PROFIL VERBINDUNGSTECHNIK GMBH & CO. KG et al.			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.


2. This REPORT consists of a total of 10 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 14 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☒ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 22/04/1997	Date of completion of this report
Name and mailing address of the IPEA/  European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Authorized officer Gelder, K Telephone No. (+49-89) 2399-2421



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP96/04188

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-38 as originally filed

Claims, No.:

1-52 as received on 23/10/1997 with letter of 23/10/1997

Drawings, sheets:

1/11-11/11 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.
- ☐ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/EP96/04188

2. ☒ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
- ☐ complied with.
- ☒ not complied with for the following reasons:
- see separate sheet**
4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:
- ☒ all parts.
- ☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims 1 - 52
	No: Claims
Inventive step (IS)	Yes: Claims 1 - 8, 10 - 28, 32 - 38, 48 - 52
	No: Claims 9, 29 - 31, 39 - 47
Industrial applicability (IA)	Yes: Claims 1 - 52
	No: Claims

2. Citations and explanations

see separate sheet

VI. Certain documents cited

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

see s parat sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/EP96/04188

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

1. Lack of unity

The separate groups of invention are: (1) Claims 1 - 9, 39 - 47; (2) Claims 10 - 28, and 48 - 52; (3) Claims 29 - 31; and (4) Claims 32 - 38.

They are not so linked as to form a single general inventive concept for the following reasons:

Group (1) relates to a die button design for the purpose of better flow of material into the recesses and grooves of the fastener element.

Group (2) relates to a fastener element as such, whereby a spigot-like projection has at least one cutting feature, which may be used for punching through a sheet metal component.

Group (3) relates to a riveting die having two different end face designs, which cannot be considered to be specifically for use with a fastener element of group (2) or for carrying out the method of group (1).

Group (4) relates to a component assembly with a bolt or nut element having a specific rib design, i.e. the ribs extending in raised form along the shaft portion and merging at the ends remote from the head portion into the radial groove, whereby a reliable form-locked connection between the bolt or nut element and the sheet metal component is achieved.

It should be noted that the references in claims 10 and 29 to claims of other categories are only optional due to the wording "in particular". Even without such non-binding term, the formulations "for carrying out the method in accordance with one of claims..." and "for use with a bolt element in accordance with one of claims ...", express only, that the bolt element and riveting die are suitable for such use.

2. Lack of clarity and conciseness

- 2.1 The various definitions of the invention given in independent claims 1 and 39 (group (1)) as well as 10 and 48 (group (2)), respectively, are such that the claims as a whole are not clear and concise, contrary to Article 6 PCT. The claims should

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP96/04188

therefore have been recast to include only one independent method and one independent fastener element claim, with dependent claims as appropriate (Rule 6.4(a)-(c) PCT).

- 2.2 Claim 9 is not truly dependent on claim 1 but rather extends the scope of claim 1 by defining an alternative, thus rendering the claims unclear (Article 6 PCT). In claim 1, the radial groove is defined as being located "in the transition from said head portion to said shaft portion", whereas claim 9 defines the radial groove as being formed by one or more thread turns on the shaft portion.
- 2.3 According to claim 1, a hole in the sheet metal component is formed such that a collar of material is formed at the side of the sheet metal component remote from the header portion of the fastener element. The description, p. 31, penultimate paragraph, mentions forming of the hole by drilling without a collar being formed, in contradiction to what is claimed in claim 1, thus rendering claim 1 unclear.
- 2.4 Claim 17 contains a reference to DE-A-44 10 475. Such reference renders the claim unclear (Art. 6 PCT). In addition, according to Rule 6.2(a) PCT, claims should not contain references to the description and drawings except where is absolutely necessary. Such is not, however, the case here. The claim should thus have been reformulated so as to make the intended limitations clear without referring to this document.
- 2.5 Claims 28 and 29 should refer back to claim 10 instead of claim 8 for obvious reasons.
- 2.6 Claim 29 is directed to a riveting die as such. It contains, however, features of its use by referring to the fastener element ("a diameter larger than the outer diameter of the thread"; "a smaller diameter which is fractionally larger than the outer diameter of the thread"), resulting in a lack of clarity (Article 6 PCT, see also PCT/GL/3, Chapter III, 4.8a).
- 2.7 In addition, the term "roof-like ring wall" in claim 29 is ambiguous, in particular it does not, by necessity, imply the limitations explicitly defined in claim 1.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP96/04188

- 2.8 Claim 29 includes two different embodiments ("wave-like end face" and "roof-like ring wall at the end surface"). It is not clear whether the feature concerning the central ring recess is mandatory also for the "wave-like end face" embodiment.
- 2.9 Claim 29 defines a ring shoulder. Claim 31 dependent on claim 29 defines a ring step. It is not clear, in particular in view of the description and drawings, whether the ring shoulder is the ring step or whether there is a ring shoulder and a ring step.
- 2.10 Claim 32 defines a component assembly, i.e. a product. It contains, however, features of its manufacturing process and structural features of an intermediate product ("wherein the sheet metal comprises a ring collar at the side remote from said head portion, said ring collar being deformed radially inwardly into said radial groove"). The restrictions intended by such features are not clear. It should be noted that such features have no limiting effect on the scope of the product per se.
- 2.11 Claim 41 contains a reference to claim 40 (line 2) and a reference to claim 39 (line 7). It appears that the second reference should also read "claim 40".

3. Novelty

- 3.1 Earlier (25.03.1994) patent applications DE-A-44 10 475, published 28.09.95, (&WO-A-95/26256, publ. 05.10.1995, &EP-A-0 678 679, publ. 25.10.1995) were published after priority date of the present application.

Note that no examination has been carried out on the question, whether the priority of the present international application is valid. On the assumption that the priority is validly claimed, these documents do not constitute state of the art according to Rule 64.1 b) PCT. It appears that each of these documents discloses the subject-matter of claims 29 to 31 and 32 to 38, respectively.

4. Inventive step

4.1 Claims 1 - 9

A method according to the preamble of claim 1 is disclosed in US-A-3 967 669 (D1). The underhead design of the fastener element defined in the characterising part of claim 1 ("recess provided under said head portion") is also known from D1, see for example Figure 4.

The use of a die button shaped as defined in the characterising part of claim 1 supports flow of material into the recess and groove of the fastener element, thereby improving the strength of the connection between the fastener element and the sheet metal component. Use of such a die button is not hinted at by the available prior art according to Rule 64.1 b) PCT. Consequently, the subject-matter of claim 1 involves an inventive step within the meaning of Article 33(3) PCT). Claims 2 - 8 are truly dependent on claim 1 and as such also meet the requirements of the PCT with respect to inventive step.

The tapered recess of die button as defined in claim 1 is for pressing the sheet metal component upwardly into a recess provided under said head portion of said fastener element and radially inwardly towards said shaft portion into said radial groove in the transition from said head portion to said shaft portion. Claim 9 does not include the inventive concept of claim 1, since such a groove in the transition from the head portion to the shaft portion does not exist, as implied by claim 9, defining the radial groove as being formed by thread turns on the shaft portion.

4.2 Claims 39 - 47

The only feature distinguishing claim 39 over D1 is the use of a die button having a tapered recess, resulting in a tapered outer surface of the collar. Such die buttons have already been employed for the same purpose, see US-A-3 782 436 (D2), see Figures 5 and 6. Therefore, the skilled person would regard it a normal design procedure to combine all the features set out in claim 39. Thus, the subject-matter of claim 39 does not involve an inventive step, and claim 39 does not satisfy the criteria set forth in Article 33(1) PCT.

Dependent claims 40 to 47 do not appear to contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step.

4.3 Claims 10 to 28 and 48 to 52

The subject-matter of claim 10 and 48, respectively, differs from the fastener element described in WO-A-94/01688 (D3), in that the spigot-like projection or free end portion is provided with at least one cutting feature for the purpose of notching or tearing the rim of the hole of the sheet metal component on punching through the sheet metal component. This solution is not hinted at by the available prior art according to Rule 64.1 b) PCT. Consequently, the subject-matter of claims 10 and 48 involves an inventive step within the meaning of Article 33(3) PCT). Claims 11 - 28 and 49 - 52 are dependent on claims 10 and 48, respectively, and as such also meet the requirements of the PCT with respect to inventive step.

4.4 Claims 29 - 31

Due to the unclear and incomplete definition of the subject-matters indicated in claims 29 - 31, it is not apparent what is effected by them. Therefore, they cannot be regarded as inventive.

4.5 Claims 32 to 38

The component assembly defined in claim 32 differs from the assembly described in D3 in that the ribs extend in raised form along the shaft portion and merging at the ends remote from the head portion into the radial groove, resulting in a more reliable form-locked connection between the bolt or nut element and the sheet metal component is achieved. Such a rib design is not rendered obvious by the available prior art according to Rule 64.1 b) PCT. Consequently, the subject-matter of claim 32 involves an inventive step within the meaning of Article 33(3) PCT). Claims 33 - 38 are dependent on claim 32 and as such also meet the requirements of the PCT with respect to inventive step.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP96/04188

5. Request for correction of claim 1

With letter of 25.11.97, the applicant has requested deletion of the word "is" after "being" in line 7 of claim 1. The applicant's attention is drawn to the fact that, as a consequence of Rule 66.8(a) PCT, the examiner is not permitted to carry out any amendments under the PCT procedure, however minor these may be.

Druckexemplar

Patent Claims

1. Method of joining a bolt or fastener element (10), having a head portion (12), a shaft portion (16) and at least one radial groove in its shaft portion, to a sheet metal component (52) by forming a hole in said sheet metal component in such a way that a collar (120) of material is formed at the side of the sheet metal component remote from the head portion of said fastener element, with the material of said collar (120) being subsequently deformed radially inwardly into said radial groove (28) by a die button, characterised in that a die button is used having a ring-shaped projection provided at its end face surrounding a tapered recess (112) and having sloping flanks (222,226) for pressing said sheet metal component upwardly into a recess (20) provided under said head portion (12) of said fastener element (10) and radially inwardly towards said shaft portion (16) into said radial groove (28) in the transition from said head portion (12) to said shaft portion (16).
2. Method in accordance with claim 1, wherein a base portion (113) of said tapered recess (112) serves to define the axially outermost end of said collar (120) when deformed into engagement with said element.
3. Method in accordance with claim 2, characterised by the steps of
- guiding the fastener element by means of a setting head through the sheet metal component (52) or through another plate-like component consisting of deformable material, with an end (100) of said

shaft portion remote from the head portion (12) being at the front, and with the sheet metal component (52) being pierced by the end (100) of the shaft portion (16) under the action of the setting head (38) thus forming a hole in the sheet metal component (52) on penetration thereof by said end (100) with the formation of said collar (120) and the ejection of a slug (116), and

- broadening the hole formed in the sheet metal part (52) by the pushing through of the thread (14) formed at the shaft part (16) of the bolt element, with the simultaneous dilation of the collar (120) which is located around the hole on the die side.

4. Method in accordance with claim 3, wherein said collar (120) which is formed during the piercing of said sheet metal component and which surrounds said hole at the die side is dilated as said shaft portion is pushed through said hole.
5. Method in accordance with claim 3 or claim 4, characterised in that the end (100) of the shaft portion (16) remote from the head portion (12) is used not only to push out the slug (116) from the sheet metal component (52), but rather also to generate at least one and preferably a plurality, and in particular a non-even number of notches, or at least substantially radially directed cuts or tears in the rim of the hole.
6. Method in accordance with any one of the claims 3, 4 or 5, characterised in that the piercing of said sheet metal component is effected using a bolt element (10) which has a spigot-like projection (101) at its end (100) remote from the head portion (12), with said projection

having a diameter which is somewhat smaller than the core diameter of the thread.

7. Method in accordance with claim 6, wherein a conically divergent portion of said spigot-like projection (101) adjacent said thread is used for initial dilation of said hole.
8. Method in accordance with claim 7, wherein shape features (106) provided at said spigot-like projection (101) are used to exert a cutting action at the rim of said hole.
9. Method in accordance with any one of the preceding claims, wherein the step of deforming the material of said collar radially inwardly into said radial groove comprises deforming the material of said collar radially inwardly into one or more thread turns (28) on the shaft portion of the element, said one or more thread turns forming said radial groove.
10. A fastener element (10) which can be inserted by riveting into a sheet metal component (52), in particular a bolt element (10), the element (10) consisting of a shaft portion (16) and a head portion (12) formed in one piece therewith, in particular for carrying out the method in accordance with one of the claims 1 to 9, wherein the rivet connection to the sheet metal component takes place in the region of the head portion (12) and wherein the shaft portion (16), which is preferably equipped with a thread, is formed at its end remote from the head portion (12) to punch through the sheet metal component, characterised in that the end (100) of the shaft portion (16) remote from the

head portion (12) has a spigot-like projection (101), having an outer diameter which is smaller than the core diameter of the shaft portion, said shaft portion preferably being provided with a thread, and in that the spigot-like projection (101) has at least one, and preferably a plurality of cutting features (106), in particular a non-even number of cutting features which, on punching through the sheet metal component, slightly notch or tear the rim of the hole at the corresponding positions.

11. Bolt element in accordance with claim 10, characterised in that the spigot-like projection (101) merges via a truncated cone section (102) into the thread, the truncated cone section preferably having a cone angle of approximately 90° .
12. Bolt element in accordance with claim 11, characterised in that the cutting features (106) are formed by grooves which extend in the longitudinal direction of the projection (101) and which are in particular of V-shape in cross-section and the depth of which reduces in the axial direction of the shaft portion in the direction towards the thread and preferably goes to zero in front of the thread, with the one side wall (108) of each V-shaped groove preferably lying in a radial plane.
13. Bolt element in accordance with claim 11, characterised in that the cutting features are formed by ribs on the spigot-like projection in the longitudinal direction thereof, with the ribs preferably lying within a circle coaxial to the thread, said circle having a diameter smaller than the core diameter of the thread.

14. Bolt element in accordance with any one of the claims 10 to 13, characterised in that the spigot-like projection has a so-called Ka-shape in accordance with DIN 78 or an Asp-shape in accordance with DIN 78 (German Industrial Standard 78).
15. Bolt element in accordance with one of the preceding claims 10 to 14, characterised in that the end face (104) of the shaft portion remote from the head portion (12) is a surface which is at least substantially perpendicular to the mean longitudinal axis of the bolt element and which can optionally be slightly concave or convex.
16. Bolt element in accordance with one of the preceding claims 10 to 15, characterised in that the first thread turns of the thread (14) are made substantially harder than the following turns of the thread.
17. Bolt element in accordance with one of the preceding claims 10 to 16, characterised in that the head portion (12) of the bolt element is formed in accordance with the German patent application P 44 10 475.8, and in particular in that the element (10) has peripherally closed fields at its concave lower side serving as a contact surface (18), with the concave fields being at least partly bounded by ribs (22) extending outwardly away from the shaft portion (16), and with the shaft side ends (24) of the ribs (22) extending in raised form along the shaft portion (16) and merging at the ends (26) remote from the head portion (12) into at least one recess (28) extending spirally around the shaft portion.
18. Bolt element in accordance with claim 17, characterised in that the

shaft portion (16) of the element has a larger diameter in the region of the raised ribs (28) in comparison to the shaft portion (16) remote from the head portion (12), with the at least one recess (28) being located in this region of greater diameter.

19. Bolt element in accordance with claim 17 or claim 18, characterised in that the peripherally closed fields (20) have their greatest depth adjacent to the shaft portion (16).
20. Bolt element in accordance with one of the preceding claims 17 to 19, characterised in that the proportion of the area of the fields in comparison to the contact surface (18) of the head portion are so selected that they result in an ideal security against rotation and non-critical surface pressure taking account of the material pairing.
21. Bolt element in accordance with one of the preceding claims 17 to 20, characterised in that the closed fields (20) are bounded at their radially outer boundary by a peripheral surface (30) of the head portion (12).
22. Bolt element in accordance with one of the preceding claims 17 to 20, characterised in that the rib parts (22) which are located in the contact region of the head portion (12) and preferably extend in the radial direction become broader radially outwardly and merge without interruption into a peripheral surface (20) of the contact region (18) of the head portion (12).
23. Bolt element in accordance with one of the preceding claims 17 to 22,

characterised in that the number of ribs (22) preferably lies between 6 and 8.

24. Bolt element in accordance with one of the preceding claims 17 to 23, characterised in that the closed fields (22) are at least substantially square in plan view.
25. Bolt element in accordance with one of the preceding claims 17 to 24, characterised in that the base surfaces of the closed fields (20) lie at least substantially on a conical surface having an included angle (\hat{A}) of preferably 130° to 140° .
26. Bolt element in accordance with one of the preceding claims 17 to 25, characterised in that the side of the head portion (12) remote from the contact surface (18) has a centring recess (34) extending coaxial to the longitudinal axis of the element.
27. Bolt element in accordance with one of the claims 17 to 26, characterised in that the element (10) has a thread (14), with the at least one spiral recess (28) being formed by a thread groove.
28. Bolt element in accordance with one of the preceding claims 8 to 27, characterised in that it is a functional part, for example a bearing spigot.
29. Riveting die, in particular for use with a bolt element in accordance with one of the preceding claims 8 to 28, characterised in that, for the generation of a plastic deformation of the sheet metal material, it

has either a peripherally extending wave-like end face having hills (72) and valleys (74) in the axial direction, or has a roof-like ring wall at the end surface, with the end surface having a central ring recess with a diameter larger than the outer diameter of the thread and which merges via a ring shoulder into a smaller diameter which is fractionally larger than the outer diameter of the thread .

30. Riveting die in accordance with claim 29, wherein said central ring recess has a wall 115 which tapers in diameter in the direction of the insertion of said bolt element.
31. Riveting die in accordance with claim 29 or 30, characterised in that said ring recess has a ring-step at its end remote from the roof-like ring wall.
32. Component assembly comprising a sheet metal component (52) and a bolt or nut element (10), the element (10) consisting of a shaft portion (16) and a head portion (12) formed in one piece therewith, wherein the element (10) has peripherally closed fields at its concave lower side serving as a contact surface (18), with the concave fields being at least partly bounded by ribs (22) extending outwardly away from the shaft portion (16) and with the shaft side ends (24) of the ribs (22) extending in raised form along the shaft portion (16) and merging at the ends (26) remote from the head portion (12) into at least one radial groove (28) extending around the shaft portion, wherein the sheet metal comprises a ring collar (113) at the side remote from said head portion, said ring collar being deformed radially inwardly into said radial groove (28) and wherein the metal of the sheet metal com-

ponent (52) is at least partly plastically deformed into the concave fields (20) and into engagement with said ribs (22) extending outwardly away from the shaft portion (16), and with the shaft side ends (24) of the ribs (22) extending in raised form along the shaft portion (16).

33. Component assembly in accordance with claim 32, characterised in that the radially outer contour of said collar and its projection beyond the adjacent face of said sheet metal component are selected so that they lie, at least at the end remote from said sheet metal component, within or at most just contacting a recess within a nut element threaded onto said shaft portion and used to secure a second sheet metal component to the first said sheet metal component, said second sheet metal component having an aperture therein which fits with clearance around said collar.
34. Component assembly in accordance with claim 32, characterised in that the sheet metal component (52) has a groove (80) which extends at the side opposite to the contact surface (18) of the head portion (12) substantially coaxial to the longitudinal axis of the element and which is optionally interrupted.
35. Component assembly in accordance with claim 34, characterised in that the groove (80) has a wave-like base surface (81).
36. Component assembly in accordance with the claims 34 to 35, characterised in that regions which are raised above the plane of the sheet metal component (52) are provided between the groove sections

of an interrupted groove (80) for electrical contact purposes.

37. Component assembly in accordance with any one of claims 32 to 36, wherein said collar (120) has a conically tapering outer surface which tapers in the direction away from said head portion (12).
38. Component assembly in accordance with one of the claims 32 to 37, wherein said radial groove extending around said shaft portion comprises one or more thread turns.
39. A method of attaching a fastener element to a plastically deformable metal panel, said fastener element including a shank portion and an integral head portion extending radially from one end of said shank portion, and said shank portion including a radial groove generally adjacent said head portion, said method comprising the following steps:
 - forming an opening in said panel having a diameter generally equal to or greater than said fastener element shank portion, but less than said head portion,
 - deforming said panel surrounding said panel opening into a generally cone-shaped portion projecting from said panel having a minor diameter at said panel opening,
 - disposing said fastener element shank portion through said panel opening from a side of said panel opposite said projecting cone-shaped portion,

- then deforming said panel cone-shaped portion into a generally tube-shaped portion closely conforming said fastener element shank portion, thereby supporting said shank portion, and
 - using a die button having a tapered recess engaging an outer side of tube-shaped portion to deform said tube-shaped portion radially inwardly into said shank portion radial groove, thereby preventing withdrawal of said fastener from said panel opening.
40. The method of attaching a fastener element to a panel in accordance with claim 39, wherein said fastener element shank portion includes a generally cylindrical free end portion having a generally smooth external surface, said method including driving said fastener element free end portion against said panel, thereby generally simultaneously deforming said panel to form said cone-shaped portion and piercing a slug from said panel, forming said panel opening.
41. The method of attaching a fastener element to a panel in accordance with claim 40, wherein said fastener element cylindrical free end portion has a diameter less than said shank portion and said shank portion including a generally conical portion extending inwardly from said shank portion to said cylindrical free end portion, said method including driving said cylindrical free end portion of said shank portion through said panel as defined in claim 39, then driving said conical portion of said fastener element shank portion through said panel opening, thereby enlarging said panel opening and substantially simultaneously drawing said conical panel portion into said tu-

bular-shaped panel portion, then deforming said tubular panel portion radially inwardly into said shank portion radial groove.

42. The method of attaching a fastener element to a panel in accordance with claim 41, wherein said cylindrical free end portion of said shank portion includes generally longitudinally extending spaced grooves having relatively sharp edges adjacent the cylindrical surface of said cylindrical end portion, said method including driving said cylindrical end portion against said panel, tearing and piercing said panel, and forming said generally conical panel portion having a torn discontinuous edge surrounding said panel opening, then deforming said discontinuous edge radially inwardly into said radial groove in said shank portion.
43. The method of attaching a fastener element to a panel in accordance with claim 41, wherein said shank portion is externally threaded and said radial groove comprises at least one male thread generally adjacent said head portion, said method including deforming said panel tubular portion radially inwardly into the groove defined by said one male thread.
44. The method of attaching a fastener element to a panel in accordance with claim 41, wherein said radial groove in said shank portion is spaced from said head portion, said method including deforming the end of said panel tubular portion radially inwardly into said radial groove in said shank portion.
45. The method of attaching a fastener element to a panel in accordance

with claim 39, wherein said fastener element head portion includes a groove generally adjacent said shank portion, said method including deforming said conical panel portion spaced from said panel opening into said groove in said head portion substantially simultaneously with deforming said panel portion radially inwardly into said radial groove in said fastener element shank portion.

46. The method of attaching a fastener element to a panel in accordance with claim 39, wherein said shank portion of said fastener element includes a first radial groove immediately adjacent said head portion and said shank portion is externally threaded including a first plurality of male threads adjacent said first radial groove having a diameter greater than the remaining threads on said shank portion, said method including deforming said generally tube-shaped panel portion radially inwardly into said first radial groove and the radial grooves defined by said first plurality of male threads.
47. The method of attaching a fastener element to a panel in accordance with claim 46, wherein said method includes hardening said first plurality of male threads adjacent said radial groove prior to attachment of said fastener element to said panel.
48. A male fastener element for attachment to a plastically deformable metal panel, said male fastener element including a generally cylindrical shank portion having a free end and an enlarged integral, radially extending head portion at one end of said shank portion, said shank portion externally threaded to adjacent said free end portion with said free end portion having a relatively smooth cylindrical sur-

face including a plurality of generally longitudinally extending cutting grooves having relatively sharp cutting edges adjacent said smooth cylindrical surface.

49. The male fastener element in accordance with claim 48, wherein said smooth cylindrical free end portion of said male fastener element has a diameter less than the diameter of said externally threaded portion and said shank portion includes a relatively smooth conical portion extending from said threaded portion to said relatively smooth cylindrical surface of said free end portion.
50. The male fastener element in accordance with claim 48, wherein said shank portion is threaded to adjacent said head portion, including a first plurality of male threads adjacent said head portion having a diameter greater than the remaining threads on said shank portion and wherein said first plurality of threads is hardened relative to said remaining threads.
51. The male fastener element in accordance with claim 48, wherein said head portion includes a groove surrounding said shank portion extending angularly inwardly to said shank portion.
52. The male fastener element in accordance with claim 51, wherein said shank portion includes a relatively smooth radial groove adjacent said head portion.